Comparison of ASCE 7 and ASCE 43 for Informed Adoption of ASCE 7 for Seismic Design of SDC-1 SSCs

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The current editions of ASCE 43 and DOE Standard 1020 defer seismic design of SDC-1 and SDC-2 SSCs to ASCE 7 and IBC. In its upcoming edition, ASCE 43 is likely to include design provisions for SDC-2 SSCs, which will be consistent with those for higher SDCs (albeit with a higher performance goal). However, the next edition of ASCE 43 will still defer design of SDC-1 SSCs to ASCE 7/IBC. The upcoming edition of DOE Standard 1020 still defers both SDC-1 and SDC-2 SSCs to ASCE 7/IBC, and continues to provide some guidance in its Table 3-1 to adopt ASCE 7 for this purpose.

In spite of the above updates, there are two challenges that still remain:

1. Judicious adoption of a suitable performance goal for SDC-2 SSCs in the next ASCE 43 edition that is comparable to or more stringent than ASCE 7's performance goal, and
2. Lack of sufficient guidance for adopting ASCE 7 for lower SDC SSCs, especially considering that ASCE 7 is written for facility-based performance levels of Collapse Prevention and Life Safety (rather than for SSC-specific performance goals)

Regarding the first item, it is necessary to recognize ASCE 7's current performance goals. Past editions of ASCE 43, DOE-1020, and ANS 2.26 have not caught up with the risk-based design framework incorporated in ASCE 7-10. Since its 2010 edition, ASCE 7 uses a risk-adjusted seismic design spectrum with 2E-4 annual performance goal. This goal is overtly targeted for Collapse Prevention performance level in case of standard risk category structures, and implicitly targeted for Life Safety performance level in case of essential risk category structures (which involves use of seismic importance factor of 1.50 that effectively reduces the structure's inelastic Response Modification Factor from R to R/1.50). Because ASCE 7 overtly targets facility-based performance level (rather than individual SSC-based limit state), it is not so easy to infer the limit state based performance goals delivered for the individual structural and nonstructural components. In any case, for SDC-2 SSCs, it is necessary to adopt an informed performance goal value that is not lenient compared to the explicit or implicit performance goals in ASCE 7. Otherwise, it will be difficult to explain to the public why the selected performance goal is less lenient than that in ASCE 7.

Regarding the second item above, it is necessary to provide sufficient guidance in ASCE 43 and/or DOE-1020 to downstream users as to how the ASCE 7/IBC seismic provisions can be reasonably adopted for lower SDCs. This is especially true for SSCs that need to be designed to Limit States C and D since these are not addressed in ASCE 7 because they are fundamentally not relevant for Collapse Prevention or Life Safety performance level (except for essential nonstructural components, such as backup power generator or fire water pumps that are required to operate <u>after</u> the design earthquake). Also, proper application of ASCE 7 requires guidance issues such as: use of seismic importance factors for structure and nonstructural components (Table 3-1 of DOE-1020 only addresses the former); limit state based adjustment of R, Ω_o, and C_d values (Table 3-1 of DOE-1020 only addresses R-value adjustment); the potential need for calculated ISRS and explicit use of vertical spectra, especially for design at Limit States C and D; appropriate design/testing provisions for Safety-Significant and Safety-Class components, etc.

This paper will explore the above topics, and make recommendations for judicious adoption of ASCE 7.